

CLAIMS

What is claimed is:

1. A method of managing a radio channel assigned to a mobile terminal in a radio access network that supports a plurality of radio channel data rate capacities, the

5 method comprising:

monitoring usage of the radio channel over an interval of time;

increasing a data rate capacity of the radio channel if the usage remains above a maximum usage threshold for a first qualified period of time; and

10 decreasing the data rate capacity of the radio channel if the usage remains below a minimum usage threshold for a second qualified period of time.

2. The method of claim 1 further comprising:

initiating a guard timer after each increase or decrease of data rate capacity of the radio channel; and

15 suspending subsequent increases or decreases of the data rate capacity of the radio channel irrespective of the usage of the radio channel until the guard timer reaches a predetermined time-out value.

3. The method of claim 1 further comprising:

20 monitoring an error rate associated with the radio channel; and

decreasing the data rate capacity of the radio channel if the error rate exceeds a maximum error rate threshold.

4. The method of claim 3 wherein monitoring an error rate associated with the radio

25 channel comprises monitoring a frame error rate (FER) for the communication traffic carried by the radio channel.

5. The method of claim 3 wherein monitoring an error rate associated with the radio channel comprises determining the error rate as a percent error over a defined interval of time by:

determining an amount of data sent over the radio channel for the defined
interval of time that had to be re-transmitted; and
computing the percent error using a first value representing the amount of re-transmitted data and a second value representing a maximum amount of data that could have been sent over the radio channel over the same interval of time at the current data rate capacity of the radio channel.

6. The method of claim 1 wherein monitoring usage of the radio channel over an interval of time comprises determining the usage as a percentage utilization at a current data rate capacity of the radio channel by:

determining an amount of new data sent over the radio channel over the interval of time; and
computing the percentage utilization using a first value representing the amount of new data and a second value representing a maximum amount of data that could have been sent over the radio channel over the same interval of time at the current data rate capacity of the radio channel.

7. The method of claim 6 wherein the interval of time comprises one or more transmission frame times of the radio access network, and wherein determining an amount of new data sent over the radio channel over the interval of time comprises determining a total number of new data octets sent over of the radio channel during the interval of time.

8. The method of claim 1 further comprising:

initiating an up-delay timer after certain decreases of data rate capacity of the
radio channel; and

suspending subsequent increases of the data rate capacity of the radio channel

5 irrespective of the usage of the radio channel until the up-delay timer
reaches a predetermined time-out value.

9. The method of claim 8 wherein initiating an up-delay timer after certain
decreases of data rate capacity of the radio channel comprises:

10 determining if an up-delay trigger criteria is satisfied by determining if the usage
of the radio channel falls within a range of about one-half the maximum
usage threshold up to the maximum usage threshold; and
initiating the up-delay timer if the up-delay trigger criteria is satisfied.

15 10. The method of claim 1 wherein increasing a data rate capacity of the radio
channel if the usage remains above a maximum usage threshold for a first qualified
period of time comprises:

selecting a desired data rate capacity above a current data rate capacity of the
radio channel as indicated by a current rate value;

20 requesting that the radio channel be configured for the desired data rate
capacity;

receiving information bearing on an assigned data rate capacity if the request
was granted; and

updating the current rate value to reflect the assigned data rate capacity.

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11. The method of claim 10 further comprising:

determining whether it is permissible to increase the data rate capacity of the
radio channel beyond an initially allocated data rate capacity; and
performing the steps of selecting, requesting, receiving, and updating only if it is
permissible to increase the data rate capacity of the radio channel beyond
the initially allocated data rate capacity.

12. The method of claim 11 wherein determining whether it is permissible to increase
the data rate capacity of the radio channel beyond an initially allocated data rate
capacity comprises accessing subscriber-specific information bearing on a subscriber
associated with the mobile terminal to which the radio channel is assigned.

13. The method of claim 11 wherein determining whether it is permissible to increase
the data rate capacity of the radio channel beyond an initially allocated data rate
capacity comprises accessing system configuration information that indicates whether
the increase is permissible.

14. The method of claim 10 wherein requesting that the radio channel be configured
for the desired data rate capacity comprises sending a request to an associated process
in the radio access network that controls radio channel allocation and configuration.

15. The method of claim 1 wherein decreasing the data rate capacity of the radio
channel if the usage remains below a minimum usage threshold for a second qualified
period of time comprises:

comparing a usage of the radio channel to fractional thresholds of the minimum
usage threshold; and

selecting a desired data rate capacity based on between which of the fractional
thresholds the usage lies; and
requesting that the radio channel be configured for the desired data rate
capacity;
5 receiving information bearing on an assigned data rate capacity if the request
was granted; and
updating the current rate value to reflect the assigned data rate capacity.

16. The method of claim 1 further comprising:
10 decreasing the data rate capacity of the radio channel if an error measurement
for the radio channel exceeds a maximum error threshold;
setting an up-delay timer to a desired expiration period; and
suspending subsequent increases in the data rate capacity of the radio channel
irrespective of the channel usage until the up-delay timer expires.

15 17. The method of claim 16 further comprising configuring the expiration period of
the up-delay timer based on a current data rate capacity of the radio channel with
respect to a maximum data rate capacity as defined by the radio access network.

20 18. The method of claim 1 wherein the radio access network is an IS-2000 based
network, and wherein monitoring usage of the radio channel over an interval of time
comprises:

monitoring Radio Link Protocol (RLP) usage over an interval of one or more
transmission frames; and

25 determining an amount of new RLP data sent during the interval.

19. The method of claim 18 wherein the radio channel is a supplemental channel in the IS-2000 based network and increasing a data rate capacity of the radio channel if the usage remains above a maximum usage threshold for a first qualified period of time comprises issuing a request for a base station controller within the IS-2000 based network that is managing the radio channel to increase the data rate capacity of the supplemental channel to a higher one of a defined number of data rate settings.

20. The method of claim 18 wherein the radio channel is a supplemental channel in the IS-2000 based network and further comprising de-allocating the supplemental channel if the usage of the radio channel is below the minimum usage threshold and a current data rate capacity of the supplemental channel is a lowest defined data rate capacity.

21. The method of claim 1 further comprising de-allocating the radio channel if the usage is below the minimum usage threshold and a current data rate capacity of the radio channel is at a minimum data rate capacity as defined for the radio access network.

22. The method of claim 1 wherein the radio access network is an IS-2000 based network and the radio channel is a supplemental channel, and further comprising:
before initial allocation of the supplemental channel to the mobile terminal,
determining whether a fundamental channel that is allocated to the mobile terminal has a sufficient data rate capacity; and
allocating the supplemental channel to the mobile terminal if the data rate capacity of the fundamental channel is not sufficient.

23. The method of claim 22 further comprising selecting an initial data rate capacity of the allocated supplemental channel based on subscriber-specific information associated with the mobile terminal.

5 24. The method of claim 22 wherein determining whether a fundamental channel that is allocated to the mobile terminal has a sufficient data rate capacity comprises monitoring a data queue length used to queue communication traffic sent over the fundamental channel to determine whether a defined maximum data queue length is exceeded.

10 25. The method of claim 22 wherein determining whether a fundamental channel that is allocated to the mobile terminal has a sufficient data rate capacity comprises monitoring packet data size for communication traffic sent over the fundamental channel to determine if a defined maximum packet data size is exceeded.

15 26. The method of claim 1 wherein increasing a data rate capacity of the radio channel if the usage remains above a maximum usage threshold for a first qualified period of time comprises assigning a new radio channel to increase a data rate capacity to the mobile terminal.

20 27. A method of data rate management in a radio access network capable of adjusting radio channel data rate capacity, the method comprising:
monitoring channel utilization for a radio channel carrying communication traffic to a mobile terminal;

increasing a data rate capacity for said radio channel if channel utilization
exceeds a first utilization threshold and if an increase in data rate capacity
is permissible; and
decreasing the data rate capacity for said radio channel if channel utilization is
5 below a second utilization threshold and if a decrease in data rate
capacity is permissible.

28. The method of claim 27 further comprising:
monitoring an error term associated with said radio channel; and
10 decreasing the data rate capacity for said radio channel if said error term
exceeds a first defined error threshold and if a decrease in data rate is
permitted.

29. The method of claim 27 further comprising:
15 initiating a first timer upon each increase or decrease of data rate capacity for
said radio channel; and
suspending subsequent increases or decreases of data rate capacity for said
radio channel until expiration of said first timer.

20 30. The method of claim 27 further comprising:
starting a high duration timer to time a period of time that said channel utilization
exceeds said first utilization threshold; and
deferring any action to increase said data rate capacity until said high duration
timer reaches a predetermined high condition count.

31. The method of claim 30 further comprising:
incrementing a count value of said high duration timer on a periodic basis; and
evaluating whether an accumulated count value of said high duration timer has
reached said predetermined high condition count to determine whether a
subsequent data rate capacity adjustment is permitted.

32. The method of claim 27 further comprising:
starting a low duration timer to time a period of time that said channel utilization
remains below said second utilization threshold; and
deferring any action to decrease said data rate capacity until said low duration
timer reaches a predetermined low condition count.

33. The method of claim 32 further comprising:
incrementing a count value of said low duration timer on a periodic basis; and
evaluating whether an accumulated count value of said high duration timer has
reached said predetermined low condition count to determine whether a
subsequent data rate capacity adjustment is permitted.

34. A computer readable media comprising software for instructing a processing
system in a radio access network to:
monitor usage of a radio channel assigned to a mobile terminal supported by the
radio access network;
increase a data rate capacity of the radio channel if usage exceeds a maximum
usage threshold for a defined interval of time; and
decrease a data rate capacity of the radio channel if usage remains below a
minimum usage threshold for a defined interval of time.

35. The computer readable media of claim 34 for further instructing the processing system to de-allocate the radio channel if the usage falls below the minimum usage threshold and if a current data rate capacity of the radio channel is at a minimum defined value.

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36. The computer readable media of claim 34 for further instructing the processing system to determine usage as a percentage utilization value based on comparing an actual amount of new communication traffic sent over the radio channel over the defined interval of time versus a maximum amount of communication traffic that could have been sent if the radio channel was fully utilized.

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37. The computer readable media of claim 34 for further instructing the processing system to:

determine an error rate for communication traffic sent over the radio channel; and
decrease the data rate capacity of the radio channel if the error rate exceeds a
maximum error rate threshold.

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38. The computer readable media of claim 37 for further instructing the processing system to determine the error rate for communication traffic sent over the radio channel as a percentage error rate by comparing an amount of communication traffic re-transmitted over the defined interval of time against a maximum amount of communication traffic that could have been transmitted at a current data rate of the radio channel of the defined interval of time.

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39. The computer readable media of claim 34 for further instructing the processing system to:

initiate a guard timer each time the data rate capacity of the channel is increased or decreased; and

5 suspend subsequent increases or decreases of the data rate capacity until expiration of the guard timer.

40. The computer readable media of claim 34 for further instructing the processing system to:

10 selectively initiate an up-delay timer upon decreasing the data rate capacity of the radio channel; and

suspend subsequent increases of the data rate capacity of the radio channel until expiration of the up-delay timer.

15 41. The computer readable media of claim 40 for further instructing the processing system to set an expiration period of the up-delay timer in proportion to the current data rate capacity of the radio channel such that the expiration period is longer for higher data rate capacities of the radio channel.

20 42. A base station controller system in a radio access network comprising a processing system operative to:

allocate a radio channel to a mobile terminal, wherein the radio channel is configured with an initial data rate capacity;

monitor usage of the radio channel based on an amount of communication traffic

25 sent over the radio channel over a defined interval of time;

increase the data rate capacity of the radio channel if the usage is above a
defined maximum usage threshold; and
decrease the data rate capacity of the radio channel if the usage is below a
defined minimum usage threshold.

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43. The base station controller system of claim 42 wherein the processing system is
further operative to de-allocate the radio channel if a current data rate capacity of the
radio channel is at a minimum and the usage is below the defined minimum usage
threshold.

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44. The base station controller system of claim 42 wherein the processing system is
further operative to limit increases of the data rate capacity of the radio channel based
on subscriber-specific information associated with the mobile terminal to which the radio
channel is allocated.

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45. The base station controller system of claim 42 wherein the processing system is
further operative to:

maintain a guard timer that is activated each time the data rate capacity of the
radio channel is increased or decreased; and

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defer subsequent increases or decreases of the data rate capacity of the radio
channel until expiration of the guard timer to prevent excessive
adjustments of the data rate capacity.

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46. The base station controller system of claim 42 wherein the base station controller
system is a cdma2000-based system and the radio channel is a supplemental radio
channel, and wherein the processing system is further operative to:

allocate a fundamental radio channel to the mobile terminal before allocating the supplemental radio channel; and
determine whether to allocate the supplemental radio channel based on utilization of the fundamental radio channel.

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47. The base station controller system of claim 46 wherein the processing system is further operative to determine an initial data rate capacity of the supplemental channel based on subscriber-specific information associated with the mobile terminal.

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48. The base station controller system of claim 46 wherein the processing system is further operative to limit increases of the data rate capacity of the supplemental channel based on a maximum allowed data rate capacity defined for the mobile terminal.